LUCIFER Mask- and Cabinet-Exchange User Manual

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Author: Frank Eisenhauer (to be replaced by the final editor)

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2 Scope of the manual

This manual describes step by step how to exchange the masks and cabinets ~~of~~ of the LUCFIER instrument. The manual should be updated on a regular basis by the instrument team to always include the latest hints and changes in the procedure.

3 Warning – Danger of Life

1. Never grab through the gates of the auxiliary cryostats. The gates are electronically controlled by the instrument electronics, and a malfunction or ~~maloperation~~ improper operation might accidentally close the valve.
2. Warning: the handling of liquid nitrogen is hazardous, and must only be done by trained and qualified personnel

4 Overview

The mask- and cabinet-exchange follows the ~~below sequence~~sequence below:

1. Preparing the mask- and cabinet exchange
2. Venting the auxiliary cryostats
3. Removal of the cabinet from the auxiliary cryostats
4. ~~Mask exchange~~Filling the cabinet with new masks
5. Loading the cabinet to the auxiliary cryostat
6. Evacuation of the auxiliary cryostats
7. Cooldown of the auxiliary cryostats
8. Transport of the auxiliary cryostats up to the level 6
9. Preparing the computer setup at the instrument platform
10. Mounting the empty auxiliary cryostats to LUCIFER
11. Evacuation of the interface flange and opening of the gates
12. Computer controlled cabinet~~-~~ transfer from LUCIFER to auxiliary cryostat
13. Close the gate and v~~V~~ent~~ing~~ the interface flange
14. Removing the auxiliary cryostat from LUCIFER
15. Mounting the auxiliary cryostat with the new magazine
16. Evacuation of the interface flange and opening of the gates
17. Computer controlled cabinet transfer from the auxiliary cryostat to LUCIFER
18. Close the gate and v~~V~~ent~~ing~~ the interface flange
19. Removing the auxiliary cryostat from LUCIFER
20. Clearing the instrument platform
21. Transport of auxiliary cryostats down to the laboratory
22. ~~Re-evacuation~~Pumping of the auxiliary cryostats

23. Warming up the auxiliary cryostat
24. Storing the auxiliary cryostats
25. Testing the new masks

The individual steps are now explained in detail in the following sections.

5 Detailed description of the individual steps

5.1 Preparing the mask- and cabinet exchange

The mask- and cabinet exchange requires that:

1. You have received the new masks. Currently the new masks will be delivered by express service from MPE Garching, Germany. In the future, the mask will be cut in Tucson and delivered with the regular LBTO transport.
2. You have received the Excel list with the mask ID numbers, the name of the institutes using the masks in their observing run, the mask names, and the path to the source lms files. You need to ~~fenter the cabinet slot and the frame number later in the cabinet exchange sequence~~ill in the frame number and cabinet slot where the masks are installed. The later information wil be needed at a later stage of the cabinet exchange. The following figure shows an example of such an excel file:

Mask ID	Cab. Slot	Frame #	Institute	mask name	lms filename
934121			MPE	M106GOODSN-4	/home/engineer/Masks_lms_file/Feb2010/mos1.106.GOODSN.lms
975013			MPE	M108GOODSN-1	/home/engineer/Masks_lms_file/Feb2010/mos1.108.GOODSN.lms
955603			MPE	M111GOODSN-2	/home/engineer/Masks_lms_file/Feb2010/mos1.111.GOODSN.lms
965647			MPE	M112GOODSN-3	/home/engineer/Masks_lms_file/Feb2010/mos1.112.GOODSN.lms
925659			MPE	M118GOODSN-6	/home/engineer/Masks_lms_file/Feb2010/mos1.118.GOODSN.lms
971238			MPE	M122GOODSN-5	/home/engineer/Masks_lms_file/Feb2010/mos1.122.GOODSN.lms
973949			IAP	M002laecosm2	/home/engineer/Masks_lms_file/Feb2010/mos1.2.laecosm2.lms
975807			IAP	M003laecosm2	/home/engineer/Masks_lms_file/Feb2010/mos1.3.laecosm2.lms
925724			MPIA	a9011	/home/engineer/Masks_lms_file/Feb2010/mos1.38.a9011.lms
925951			MPIA	a9012	/home/engineer/Masks_lms_file/Feb2010/mos1.39.a9012.lms
930135			MPIA	a9013	/home/engineer/Masks_lms_file/Feb2010/mos1.40.a9013.lms
930732			MPIA	engel2	/home/engineer/Masks_lms_file/Feb2010/mos1.42.engel2.lms
931738			MPIA	engel3	/home/engineer/Masks_lms_file/Feb2010/mos1.43.engel3.lms
932010			MPIA	engel4	/home/engineer/Masks_lms_file/Feb2010/mos1.44.engel4.lms
932129			MPIA	engel5	/home/engineer/Masks_lms_file/Feb2010/mos1.45.engel5.lms
911548			MPIA	W3Klt14	/home/engineer/Masks_lms_file/Feb2010/mos1.49.engel9.lms
925727			MPIA	W3Klt15	/home/engineer/Masks_lms_file/Feb2010/mos1.51.W3Klt15.lms
925653			MPIA	S255	/home/engineer/Masks_lms_file/Feb2010/mos1.57.S255.lms
905333			Nancy	S255_newSW	/home/engineer/Masks_lms_file/Feb2010/mos1.97.newArjan.lms

3. The auxiliary cryostats are in the instrument laboratory.
4. You have all tools available:
    a. Check content of the toolbox at the bottom of each of the auxiliary cryostat mounts.
    b. The plastic boxes labeled “MOS MASKS/FRAMES” “MOS LAPTOP/CAMERA”.
    c. The plastic box with the MOS laptop and LUCIFER webcam equipment.
    d. A clean desk.
    e. Some alcohol (ethanol) for cleaning of the new masks.
    f. A size 2 screwdriver.

To prepare the removal from the old cabinet from the auxiliary cryostat:

1. Hook up the power supply of the auxiliary cryostat (cable in toolbox at the bottom of the cryostat).
2. Hook up the pressurized air (pipe also in the toolbox).
3. Connect cable P103 from instrument electronics to J103 connector on the panel for the power- and pressurized air supply.

4. Switch on both circuit breakers (one for scroll pump, one for the control electronics) at the back of the auxiliary cryostats.
5. Check state of auxiliary cryostats:
    a. Cryostats are warm (red temperature display of the OMEGA controller, the green display is for the set point).
    b. Cryostats are still evacuated with a pressure below or around 10^{-2} mbar (pressure gauge head #1). Remark: gauge head #2 is for the vacuum interface to LUCIFER.
    c. One cryostat is loaded with the old magazine ferom the last cabinet exchange (indicated by the active “Magazine in” LED), and its thermal bridge is closed (indicated by the “Thermal bridge closed” LED active).
    d. The other cryostat is empty (“Magazine in” LED off), and its thermal bridge is open (indicated by the “Thermal bridge open” LED active)

e. The rails of the auxiliary cryostats are adjusted for a cabinet exchange with a cold LUCIFER instrument (indicated by the active “cold Pos.” LED of auxiliary cryostat #1, the indicator of auxiliary cryostat #2 is faulty and must be ignored)
Question: Will that be fixed in a near future?
Remark: the rails of the auxiliary cryostats are differently aligned if the cabinet exchange is done with a warm LUCIFER instrument. This operation is only necessary for heavy maintenance of the instrument.
f. The gates of the auxiliary cryostats are closed (indicated by the “Gate Auxiliary closed” LED active). Check also by visual inspection of the gates.
g. The “Gate LUCIFER” LED indicators are “open”. If not, toggle the switch on the panel for the power-and pressurized air supply, which simulated the state of the LUCIFER gate.
h. The scroll pump is switched off (“Scroll Pump” switch not active / off).
i. All four evacuation- and venting modes switched off (~~according~~ corresponding LEDs inactive, switches off).
j. The manual valves at the venting tube are closed.

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5.2 Venting the auxiliary cryostats

To vent the auxiliary cryostats:

1. Fully open the manual valve at the venting tube.
2. Switch on “Venting Cryostat” by pressing the ~~according~~ corresponding button on the control panel. This starts the automated venting program:
    a. The corresponding~~according~~ indicator light of the button turns on.
    b. The green LED “Venting Cryostat” starts blinking at 5Hz ~~Hz~~ to indicate the waiting period of 4 min to let spin down the turbo-molecular pump, if the cryostat was in evacuation mode before.

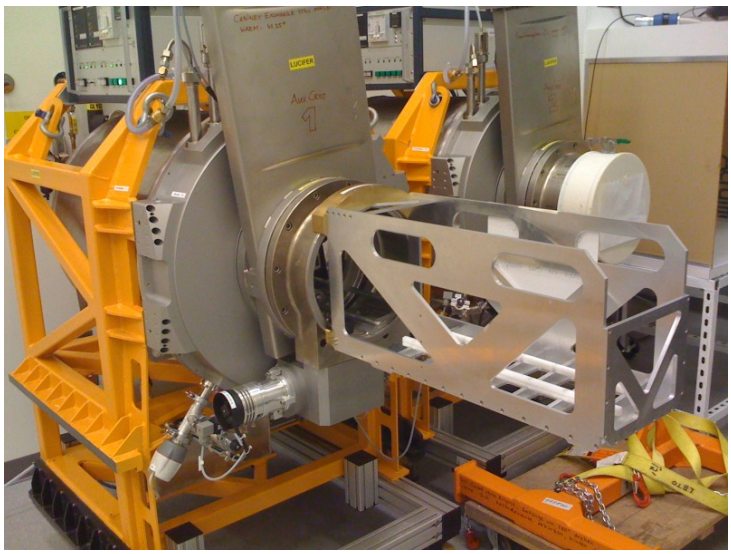
c. After the waiting period, the venting valve is automatically opened, and the green LED "Venting Cryostat" starts blinking faster at 10 Hz.
d. After the venting time of another 5 min, the green LED "Venting Cryostat" switches permanently on, indicating that the cryostat has finished its venting program.
e. Check if the cryostat is fully vented by:
    i. Verifying that the pressure gauge #1 reads more than $5x10^2$ mbar (Please note, the vacuum gauge cannot correctly measure a pressure above a few 100 mbar).
    ii. Verifying that there is no remaining "sucking sound" at the venting valve (otherwise wait for a few more minutes).
f. Open the gate by pressing the "Gate Auxiliary Open" button. You may have to press and release the button several times, especially if the gate has not been used for some time. The "Gate Auxi~~a~~liary" LED indicators will change~~turn~~ from "closed" to "open".
g. Keep the "Venting Cryostat" program running: this prevents that you accidentally close the gate, because this mode disables the "Cryostat Auxiliary Open" button.

Repeat the same procedure for both cryostats. Even so the "empty" cryostat does not necessarily needs to be vented, but could be directly evacuated and cooled (see later) to receive the cabinet from LUCIFFER, the full venting, evacuation, and cool-down procedure will provide a system level test to guarantee the proper functioning for the subsequent cabinet exchange.

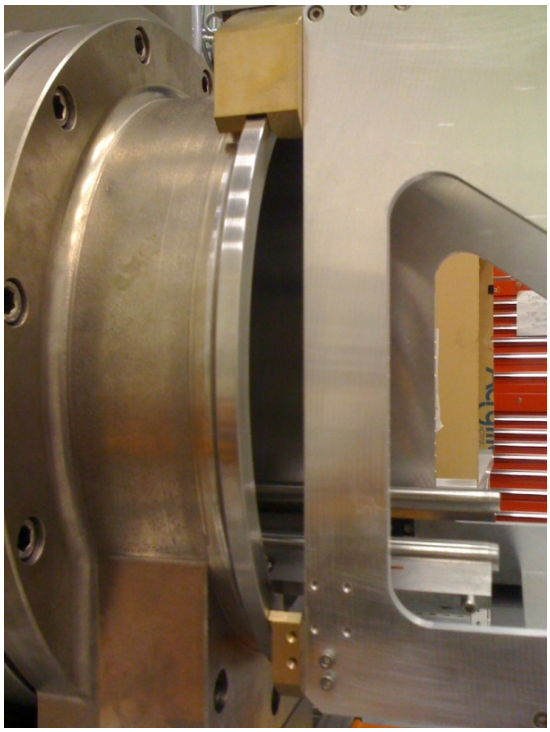
5.3 Removal of the cabinet from the auxiliary cryostats

To remove the cabinet with the old masks from the auxiliary cryostat:

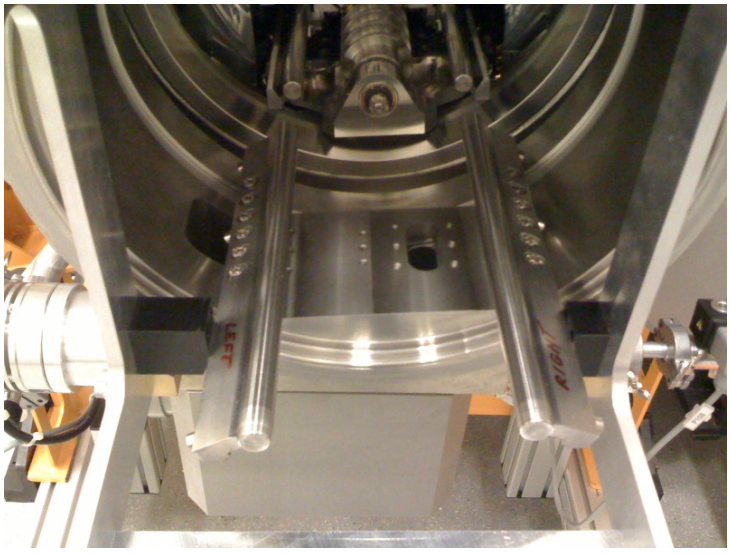
1. Attach the big aluminum frame to the gate:
    a. The frame is heavy, therefore this should ~~be always~~always be done by two persons.



b. Check the proper alignment of the frame:
    i. The copper attachment points should be aligned with the grooves on the flange.

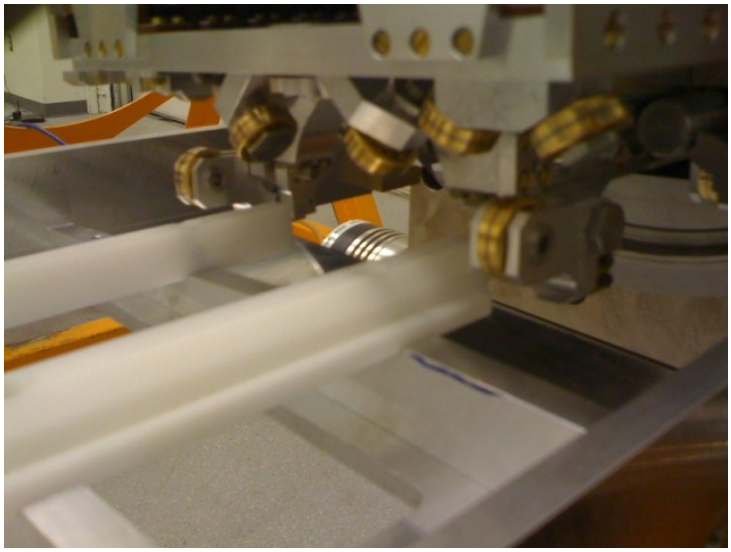


    ii. The black spacers should nicely fit the mount of the rails.

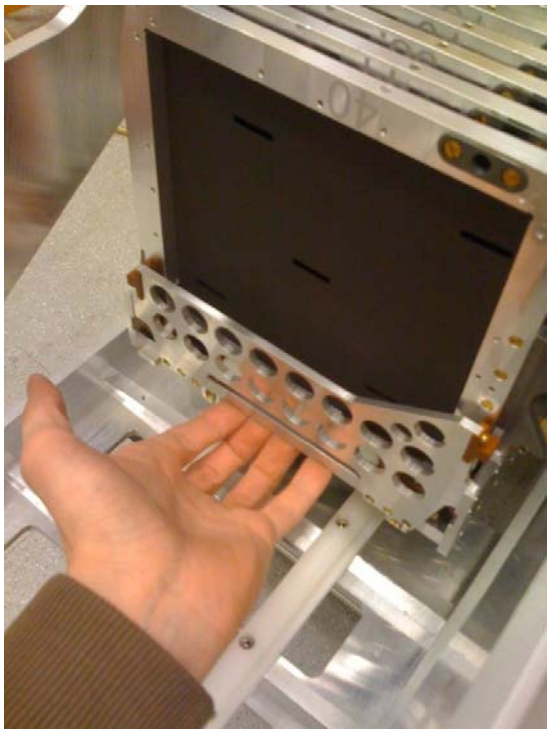


2. Open the thermal bridge by pressing the “Thermal Bridge open/close” switch up (“open”) until the “Thermal Bridge” LED indicator ~~turns~~ changes from “closed” to “open”.
3. Visually check that the thermal bridge is really open.

4. Move magazine out of the auxiliary cryostat into the aluminum frame:
    a. One person should watch the motion, the other person should operate the control panel.
    b. Switch the “Magazine in/off/out” switch from “off” to “out”.
    c. As soon as the cabinet starts moving, the “Magazine in” LED goes off, indicating that the cabinet is of the limit switch inside the auxiliary cryostat.
    d. Watch the cabinet move out the auxiliary cryostat, in particular when it is moving onto the white slide of the aluminum frame.



e. If the cabinet gets stuck at the transition to the white slides of the aluminum frame, gently lift the cabinet by hand.



f. When the cabinet reaches the end of the motorized spindle, gently pull the cabinet by hand into the aluminum frame. Do not grab through the holes of the cabinet, but grab it below on its main structure.

g. Switch off the “Magazine in/off/out” switch to stop the rotation of the spindle.
h. Keep cabinet in the aluminum frame also for the subsequent mask exchange. The cabinet is rather easily deformed, and the aluminum frame provides a proper protection.

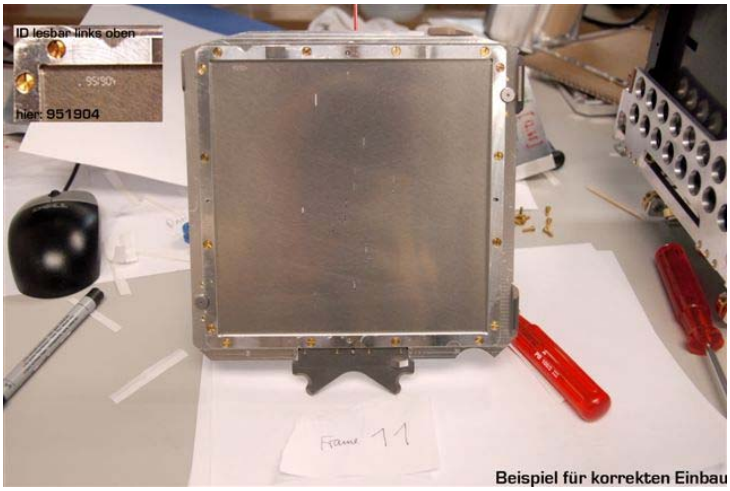
5.4 Mask Exchange

To exchange the masks:

1. Work on a soft underlay.
2. Wear latex gloves.
3. Have alcohol and cleaning paper at hand.
4. Have the Excel Sheet or a printout at hand.

The exchange of the individual mask follows the subsequent sequence:

1. Put the mask in front of you such that:
    a. The screws of the frame look up.
    b. The “ear” (this is where that MOS robot grabs the mask) is pointing towards you.
    c. The mask ID# is to the top left and readable (not mirrored).



2. Unscrew the frame.
3. Remove old mask and put it in the “Mask Archive Folder”.
4. Check that all four alignment pins are still in place, and have not loosened. If necessary, gently press them in again.
5. Clean the new mask on both sides with alcohol.
6. Place the new mask in the frame so that:
    a. The black side faces up, and the shiny side is down.
    b. The mask ID# is to the top left (opposite to the “ear”), and readable (not mirrored).
7. Screw frame.
8. Check that the mask:
    a. Has some little play (0.1 mm) in the frame by gently knocking the frame and listening for a “snare drum” like sound.
    b. No screws and pins stick out on both sides (because this could cause blocking the MOS).
9. Note down the frame ID# (laser printed on the side of the frame) in the Excel sheet.
10. Put the mask back in the cabinet:
    a. Such that the shiny side of the mask faces the front of the cabinet (this is where the cabinet is first moving out the auxiliary cryostat).
    b. The black side of the mask with the frame screw looks to the back of the cabinet (this is where the long lever arm for the cabinet drive is mounted).
11. Note down the cabinet slot id# of the frame:

If you happen to need spare screws or spare beryllium springs, you will find them in the plastic box labeled “MOS MASKS/FRAMES”.

5.5 Loading the cabinet to the auxiliary cryostat

Before inserting the cabinet back into the auxiliary cryostat, check:

1. The mask id#, frame id#, and cabinet slot id# match the entries of the Excel Sheet.
2. All masks are well aligned with each other.
3. Every mask is sitting well in its slot.
4. The auxiliary cryostat control electronics is still in “Venting Cryostat Mode”:
    a. The ~~according~~ corresponding switch is light up .
    b. The “Venting Cryostat” LED indicator is permanently on (not flashing).
5. The “Gate Lucifer open” LED indicator is on (if not, toggle the ~~according~~ corresponding switch on the power-supply panel see §4.1).

Then insert the cabinet back in the auxiliary cryostat:

1. Attach the big aluminum frame with the cabinet to the gate following the instructions in §4.3.
2. Check the proper alignment of the frame following the instructions in §4.3.
3. Make sure that the thermal bridge is open:
    a. The “Thermal Bridge open” LED indicator is on.
    b. Visual inspection through the gate.
5. Move magazine ~~out of the auxiliary cryostat into the aluminum frame~~from the aluminum frame into the auxiliary cryostat:
    a. One person should watch the motion, the other person should operate the control panel.
    b. Switch the “Magazine in/off/out” switch from off to in.

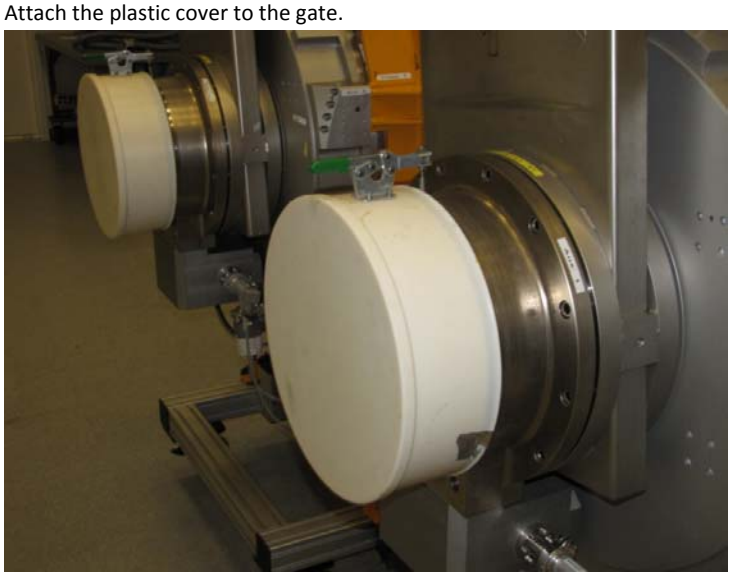
c. Gently push the cabinet at its main structure (not at the side wall with the holes (see §4.3) towards the auxiliary cryostat until the rotating spindle picks up the cabinet and pulls it into the auxiliary cryostat.
d. As soon as the cabinet is fully inside the auxiliary cryostat and reaches the limit switch:
    i. The spindle motor will stop.
    ii. The "Magazine in" LED indicator will light up.
e. Switch off the "Magazine in/off/out" switch .

6. Close the thermal bridge by pressing the "Themal Bridge open/close" switch down until the "Thermal Bridge closed" LED indicator will switch on.
7. Remove the big aluminum frame.

5.6 Evacuation of the auxiliary cryostats

Evacuate both cryostats. To evacuate the auxiliary cryostat:

1. Check that the gate is free and no items could block its way.
2. Attach the plastic cover to the gate.



3. Switch off the "Cryostat Venting Mode" by releasing the ~~according~~ corresponding button. The button light and the "Cryostat Venting" LED indicator must go off.
4. Close the gate of the auxiliary cryostat by pressing the "Gate Auxiliary Close" button. You may have to repeat this several times until the gate really close, in particular, if it has not been operated for some time. The "Gate Auxiliary closed" LED indicators must go on.
5. Switch on the scroll pump by pressing the "Scroll Pump" button switch. The light of the "Scroll Pump" button must turn on.
6. Start turbo molecular pump by pressing the "Evacuation Cryostat" button:
    a. The light of the button will turn on.
    b. The controller will wait for the scroll pump to evacuate ~~for a pressure better than~~down to a pressure below 10^{-1} mbar, and then switch on the turbo pump.

c. The ~~according~~ corresponding "ACCEL" LED indicator of the "Pump Auxiliary Cryostat" turbo controller will turn on, until the turbo pump reaches it nominal speed.
d. The ~~according~~ corresponding "NOMINAL" LED indicator of the "Pump Auxiliary Cryostat" turbo controller will turn on.

7. Wait for the pressure to be below 10^{-4} mbar. The ~~according~~ corresponding "Evacuation P<10^{-4}" will turn on.

5.7 Cooldown of the auxiliary cryostats

The cooldown of the two auxiliary cryostats:

1. Requires about 200 liter of liquid nitrogen.
2. Takes about 24 hours.

To cooldown the auxiliary cryostats:

1. Make sure that the cryostat heater is switched of, the ~~according~~ corresponding "Heater ON" switch must be off, and the "Warm up" LED indicator off.
2. Pressure up the LN2 canister to 40 PSI.
3. Remove the cup from the LN2 input pipe of the auxiliary cryostat.
4. Remove the overpressure valve from the LN2 exhaust pipe.
5. Connect the LN2 canister to the auxiliary cryostat.
6. Open the valve at the LN2 canister.
7. Fill the auxiliary cryostat until liquid nitrogen spills out from the exhaust pipe.
8. Close valve at the LN2 canister.
9. Disconnect the LN2 canister from the auxiliary cryostat.
10. Put cup on the LN2 Input pipe.
11. As soon as the nitrogen exhaust has calmed down, put the overpressure valve.

Important: To avoid icing inside the cryostat (Danger of Life):

- Never leave LN2 input pipe open.
- Always put the overpressure valve on the exhaust pipe, as soon as the exhaust has calmed down.

12. Repeat steps 2-10 until the auxiliary cryostat is below about -180° C (read display of the OMEGA controller)

When the cryostat is fully cooled down, the typical LN2 hold time is about 12 hours.

5.8 Transport of the auxiliary cryostats up to the level 6

For the transport of the auxiliary cryostats, you first need to stop evacuation and power down the cryostat:

1. Stop evacuation by switching off the "Evacuation Cryostat" button. The ~~according~~ corresponding button light must go off.

2. Stop scroll pump by switching off the “Scroll Pump” button. The correspondingaccording button light must go off.
3. Wait for 5 minutes to let the turbo-pump spin down.
4. Switch off power-supply for the scroll pump and the control electronics on the back of the E-cabinet.
5. Unplug the power supply and put power line in the tool box at the bottom of the cryostat.
6. Unplug the pressurized air and put pipe into the tool box at the bottom of the cryostat.
7. Unplug P103 fromorm the power supply panel and fix cable to the frame of the auxiliary cryostat.

Then bring up the cryostat to level 6:

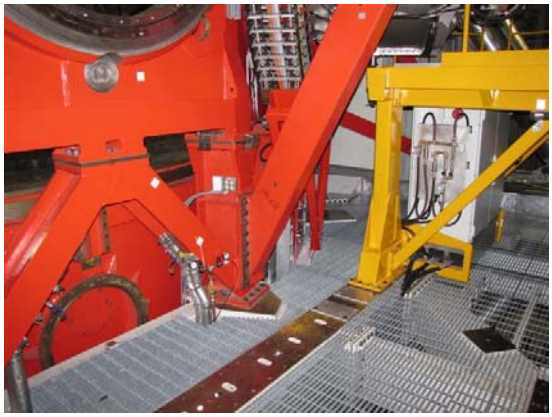
1. Move cryostat below the hatch up to the telescope.
2. Hook auxiliary cryostat crane support structure to the telescope crane .
3. Hook auxiliary cryostat to the support structure:
    a. On the side with the gate, adjust the length of the chain by placing the according corresponding hook in the 9th chain element.
    b. On the other side, no adjustment is needed.
4. Lift up cryostat to level 5.
5. Bring up trolley to level 5 using the elevator.
6. Place auxiliary cryostat back on its trolley.
7. Bring up the auxiliary cryostat to level 6 using the elevator.
8. Bring up auxiliary cryostat crane support to level 6 using a trolley and the elevator.

5.9 Preparing the computer setup at the instrument platform

The MOS laptop and all necessary accessories are available from the “MOS LAPTOP/CAMERA” plastic box. This box also includes the equipment for running the LUCIFER internal webcam, but the use of the webcam is not part of the regular cabinet exchange, but only necessary for debugging and maintenance.

To setup the MOS laptop on the instrument platform:

1. Get the small table from the access area up to the platform.
2. Connect MOS Laptop to its power supply using the dedicated power extension (changing from US to European socket). The battery might be low, so always run on external power.
3. Connect USB mouse.
4. Connect LAN cable to the port below the central focal station.



5. Power up the laptop (login and password also printed on top of the screen):
    a. Login: mos
    b. Password: ~~mos0p~~....
6. After the startup you will find a readme file *(where and which name)* with more detailed instructions on:

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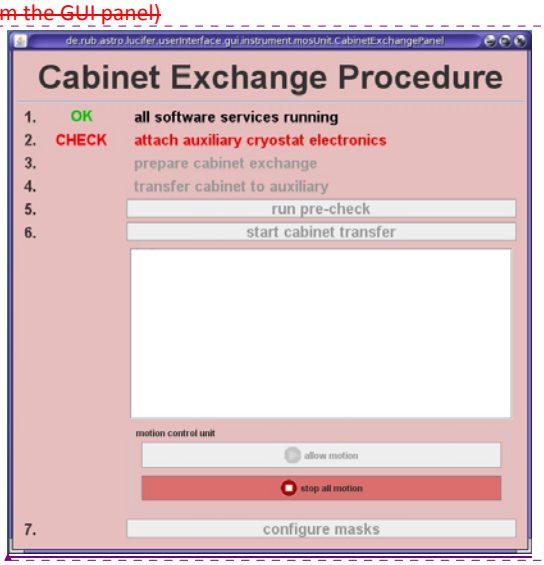
a. How to remotely login to the LUCIFER instrument workstation.
b. How to start remote access from Garching.
c. How to install and run the LUCIFER Webcam.

7. Double-click the “Run VNC Server” Icon on the Desktop to start the VNC server. This will allow MPE Garching to have remote access to your Display/Mouse/Keyboard. The running VNC client will show up as a white symbol in the Windows task bar. It will turn green if MPE Garching is remotely connected.
8. Double-click the “Skype” icon on the Desktop, and call remote support from Garching.
9. Double-click the “SUN_LBT” icon on the Desktop for remote access to the LUCIFER workstation:
   a. Login: engineer
   b. Password: ~~LBT123~~.....
   c. In the "NX - Available Sessions" popup window press "New" to create a new session.

   This will open a full-screen X-terminal. From now on, work in this terminal window.
10. Double-click the "Cabinet Exchange Gui" icon on the instrument workstation desktop. It will open the following panel:

~~(add screen shot from the GUI panel)~~



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5.10 Mounting the empty auxiliary cryostats to LUCIFER

Before continuing with the software controlled cabinet transfer, the auxiliary cryostat must be ~~mounted~~ attached to LUCIFER:

1. Check that the instrument rotator is at 341°
2. Interlock the rotator.
3. Remove plastic cover from the LUCIFER vacuum flange.
4. Remove plastic cover f~~o~~rom the auxiliary cryostat flange.
5. Hook auxiliary cryostat to the crane support structure:

a. On the side with the gate, adjust the length of the chain by placing the ~~according~~ corresponding hook in the 9th chain element.
b. On the other side, no adjustment is needed.

6. Lift the auxiliary cryostat with the telescope crane on the rails in front of the LUCIFER gate. Watch out for the ~~cabling~~cables.

7. Put the O-ring on the LUCIFER gate:
   a. You will find the O-ring, cleaning tissues, and vacuum crease in the toolbox below the auxiliary cryostat.
   b. Clean the O-ring and the ~~according~~ corresponding nut on the gate.
   c. Crease the O-ring.
   d. Put the O-ring in the nut.

   The O-ring is slightly smaller than the nut, so use a lot of crease to keep it stick in the nut.
8. Push the auxiliary cryostat on its rail onto the LUCIFER gate.
9. Check the alignment of the auxiliary cryostat.

10. Put the clamps (also in the toolbox below the auxiliary cryostat) to fix the vacuum flanges.

11. Connect the power-supply and the pressurized air to the auxiliary cryostat panel (see also §4.1, power cord and tubes also in the toolbox below the auxiliary cryostat).

12. Connect the two cables P102 and P103 from the auxiliary cryostat to the LUCIFER control electronics sockets J102 and J103.

13. Connect the cable P19 from the auxiliary cryostat to the J19 socket in the back of the MOS control electronics.

14. Disconnect the two cables P115 and P116 from the auxiliary cryostat.
15. Instead connect the two cable P15 and P16 coming from the MOS control electronics to the sockets J115 and J116 close to the gate of the auxiliary cryostat. You will find the cables P15 and P16 tied to the LUCIFER cryostat.

16. Connect the second line of the pressurized air to the LUCIFER cryostat panel (next to the sockets J105 and J106, see picture of step 7)

5.11 Evacuating the interface flange and opening the gates

To evacuate the interface flange:

1. Switch on both circuit breakers (one for scroll pump, one for the control electronics) at the back the auxiliary cryostats.
2. Press the “Scroll Pump” button on the auxiliary cryostat control electronics to start the scroll pump. The ~~according~~ corresponding button light turns on.
3. Verify that the “Evacuation $P_{Aux} > P_{VI}$” LED indicator is off, otherwise re-evacuate auxiliary cryostat (see §4.6).
4. Press the “Evacuation VI & Cryostat” button to start the evacuation of the vacuum interface between the auxiliary cryostat gate and the LUCIFER gate:
    a. The light of the button will turn on.
    b. The controller will wait for the scroll pump to evacuate the vacuum interface for a pressure better than 10^{-1} mbar , and then switch on the turbo pump.
    c. The ~~according~~ coresponding “ACCEL” LED indicator of the “Pump Vacuum Interface” turbo controller will turn on, until the turbo pump reaches it nominal speed.
    d. The ~~according~~ corresponding “NOMINAL” LED indicator of the “Pump Vacuum Interface Cryostat” turbo controller will turn on.

    As soon as the pressure of the vacuum interface falls below 10^{-3} mbar, the turbo pump of the auxiliary cryostat will automatically start:
    e. The corresponding~~according~~ “ACCEL” LED indicator of the “Pump Auxiliary Cryostat” turbo controller will turn on, until the turbo pump reaches it nominal speed.
    f. The corresponding~~according~~ “NOMINAL” LED indicator of the “Pump Auxiliary Cryostat” turbo controller will turn on.

Then open the gates:

1. Wait until the pressure of the auxiliary cryostat and the vacuum interface is below 10^{-4} mbar:
    a. Toggle “Head Select” on the vacuum meter to switch between the two gauges.
    b. Check that the “Evacuation P<10^{-4}” LED indicator is on.
2. Open the auxiliary cryostat gate by pressing the “Gate Auxiliary Open” button. You may need to repeat this several times, in particularly when the gate was not used for some time. The ~~according~~ corresponding “Gate Auxiliary” LED indicators will change from “closed” to “open”.
3. Check again that the pressure of the auxiliary cryostat and the vacuum interface is below 10^{-4} mbar:
    a. Toggle “Head Select” on the vacuum meter to switch between the two gauges.
    b. Check that the “Evacuation P<10^{-4}” LED indicator is on.
4. Open the LUCIFER cryostat gate by pressing the “Gate LUCIFER Open” button. You may need to repeat this several times, in particularly when the gate was not used for some time. The ~~according~~ corresponding “Gate LUCIFER ” LED indicators will change from “closed” to “open”.
5. Check pressure of the LUCIFER cryostat. The pressure should not raise above 10^{-6} mbar when opening the gate. Monitor the LUCIFER pressure repeatedly while the gate is open.

5.12 Computer controlled cabinet transfer from LUCIFER to auxiliary cryostat

The actual cabinet transfer from LUCIFER to the auxiliary cryostat is controlled by the "Cabinet Exchange Gui" (see §4.9):

1. Verify “OK” in “1. … All software services running”.
2. Verify “OK” in “2. … auxiliary cryostat … connected”.
3. Check that aux-ID shown in “2. … auxiliary cryostat … connected” is the same as the one of the auxiliary cryostat mounted to LUCIFER (remark: the two auxiliary cryostats require a different software configuration).
4. Verify “OK” in “3. … gate open” .
5. Verify “OK” in “4. … transfer …” .
6. Check that the transfer direction of “4. … transfer …” is “cabinet to AUX” (check naming).
7. Press “run pre-check” button on line “5”:
    a. A window will pop up indicating the state of LUCIFER.
    b. Check that the symbol in the first line is “grey”.
    c. If the symbol in the first line is red, you can use the decision tree to diagnose the reason for the failed pre-check, and accordingly correct the state. Most likely you will need to contact remote support from Garching. In any case, close LUCIFER gate.
    d. Close pre-check window.
    e. Verify “OK” in “5. … run pre-check”.
8. Press “start cabinet transfer”.
    a. You can follow the progress of the cabinet exchange in the sequence window.
    b. At the end of the sequence a post-condition check will be executed, and ~~an according~~a corresponding window will pop up.
    c. Check that the symbol in the first line is “grey”.
    d. If the symbol in the first line is red, you can use the decision tree below to diagnose the reason for the failed post-check, and accordingly correct the state. Most likely you will need to contact remote support from MPE Garching.
    e. Close the post-check window.
    f. Verify “OK” in “6. … start cabinet transfer” at the end of the sequence.
9. If for some reason you have to manually “stop all motions”, you need to manually recover from the state using the MOS engineering panel. This will usually require remote support from Garching.
10. Press “Configure Masks” in line 7 of the GUI:
    a. This will open the configuration editor.
    b. Disable all masks of the cabinet (slot # 10-32).
    c. Press “Commit”. Do not kill the window, otherwise the “Cabinet Exchange Procedure” GUI will not be able to successfully finish.
11. While you are configuring the mask, another person should already close the LUCIFER gate.

5.13 Venting the interface flange

To vent the interface flange:

1. Close the LUCIFER gate by pressing the “Gate Lucifer close” button. You may need to repeat this several times. The ~~according~~ corresponding “Gate Lucifer” LED indicators will change from “open” to “close”.

2. Close the auxiliary cryostat gate by pressing the “Gate Lucifer Open” button. You may need to repeat this several times. The ~~according~~ corresponding “Gate Auxiliary” LED indicators will change from “closed” to “open”.
3. Stop the evacuation of the vacuum interface and the auxiliary cryostat by switching off the “Evacuation VI & Cryostat” button. The light of the button will turn off.
4. Stop the scroll pump by switching off the “Scroll Pump” button. The light of the button will turn off.
5. Press the “Venting Vacuum Interface” interface button to vent the interface:
    a. The ~~according~~ corresponding indicator light of the button turns on.
    b. The green LED “Venting VI” starts blinking at 5Hz Hz to indicate the waiting period of 4 min to let spin down the turbo-molecular pump.
    c. After the waiting period, the venting valve is automatically opened, and the green LED “Venting VI” starts blinking faster at 10 Hz.
    d. After the venting time of another 1 min, the green LED “Venting VI” switches permanently on, indicating that the cryostat has finished its venting program.
    e. Check if the vacuum interface is fully vented by verifying that the pressure gauge #2 reads more than $5x10^2$ mbar (Please note, the vacuum gauge cannot correctly- measure a pressure above a few 100 mbar).

5.14 Removing the auxiliary cryostat from LUCIFER

Removing the auxiliary cryostat from LUCIFER follows the reverse sequence of §5.10. See also this section for pictures illustrating the individual step.

1. Check if the vacuum interface is fully vented by verifying that:
    a. the pressure gauge #2 reads more than $5x10^2$ mbar (Please note, the vacuum gauge cannot correctly measure a pressure above a few 100 mbar) .
    b. the “Venting VI” LED indicator is permanently on.
2. Disconnect the pressurized air from the LUCIFER cryostat panel (next to the sockets J105 and J106).
3. Disconnect the two cables P15 and P16 from the auxiliary cryostat. Tie the cables to the LUCIFER cryostat.
4. Instead connect the two cables P115 and P116 from the auxiliary cryostat control electronics.
5. Disconnect the cable P19 from the back of the MOS control electronics.
6. Disconnect the two cables P102 and P103 from the LUCIFER control electronics and tie the cables to the auxiliary cryostat.
7. Disconnect the power-supply and the pressurized air from auxiliary cryostat panel.
8. Remove the clamps from the vacuum flanges.
9. Pull back the auxiliary cryostat from the LUCIFER gate.
10. Remove O-ring from the LUCIFER vacuum flange.
11. Store all accessories in the toolbox below the auxiliary cryostat.
12. Lift auxiliary cryostat down to level 6 using the crane. Watch out for the cabling.
13. Put back plastic cover on the vacuum flange of the auxiliary cryostat.

5.15 Mounting the auxiliary cryostat with the new magazine

Mounting the auxiliary cryostat with the new magazine follows exactly the same sequence as for the empty auxiliary cryostat in §5.10. Please follow instructions given in §5.10.

5.16 Evacuation of the interface flange and opening of the gates

Please follow instructions given in §5.11.

5.17 Computer controlled cabinet transfer from the auxiliary cryostat to LUCIFER

The computer controlled cabinet transfer from the auxiliary cryostat to LUCIFER is almost identical to the insertion of the cabinet from ~~in~~ LUCIFER to the auxiliary cryostat as described in §5.12, and is controlled by the "Cabinet Exchange Gui" (see §4.9):

1. Verify “OK” in “1. … All software services running”.
2. Verify “OK” in “2. … auxiliary cryostat … connected”.
3. Check that aux-ID shown in “2. … auxiliary cryostat … connected” is the same as the one of the auxiliary cryostat mounted to LUCIFER.
4. Verify “OK” in “3. … gate open” .
5. Verify “OK” in “4. … transfer …” .
6. Check that the transfer direction of “4. … transfer …” is “cabinet to Lucifer”.
7. Press “run pre-check” button on line “5”:
    a. A window will pop up indicating the state of LUCIFER.
    b. Check that the symbol in the first line is “grey”.
    c. If the symbol in the first line is red, you can use the decision tree to diagnose the reason for the failed pre-check, and accordingly correct the state. Most likely you will need to contact remote support from Garching. In any case, close LUCIFER gate.
    d. Close pre-check window.
    e. Verify “OK” in “5. … run pre-check”.
8. Press “start cabinet transfer”.
    a. You can follow the progress of the cabinet exchange in the sequence window.
    b. At the end of the sequence a post-condition check will be executed, and ~~an according~~a corresponding window will pop up.
    c. Check that the symbol in the first line is “grey”.
    d. If the symbol in the first line is red, you can use the decision tree to diagnose the reason for the failed post-check, and accordingly correct the state. Most likely you will need to contact remote support from MPE Garching.
    e. Close the post-check window.
    f. Verify “OK” in “6. … start cabinet transfer” at the end of the sequence.
9. If for some reason you have to manually “stop all motions”, you need to manually recover from the state using the MOS engineering panel. This will usually require remote support from MPE Garching.
10. Press “Configure Masks” in line 7 of the GUI:
    a. This will open the configuration editor.

b. Enter the mask ID# and enable the according slots of the cabinet according to the Excel Sheet. You need not to enter all information from the Excel Sheet, but you can do that later form the telescope control room using the MOS engineering GUI.
c. Press “Commit”. Do not kill the window, otherwise the “Cabinet Exchange Procedure” GUI will not be able to successfully finish.

11. While you are configuring the mask, another person should already close the LUCIFER gate.

5.18 Venting the interface flange

Please follow instructions given in §5.13.

5.19 Removing the auxiliary cryostat from LUCIFER

Please follow instructions given in §5.14. In addition:

1. Put plastic cover back on the LUCIFER vacuum flange
2. Remove interlock from the instrument rotator.

5.20 Clearing the instrument platform

1. Stop the software and shut down the MOS laptop:
   a. Close the “Cabinet Exchange Gui” window.
   b. Exit the NX Session by selecting "Log Out engineer" from the "Launch" button at the bottom left of the Desktop.
   c. Shutdown MOS Laptop by selecting "Herunterfahren" from the Windows Start button.
   d. Disconnect power supply and LAN cable, and put everything back to the “MOS LAPTOP/CAMERA” plastic box.
2. Clean up and remove any items from instrument platform.

5.21 Transport of auxiliary cryostats down to the laboratory

The transport of the auxiliary cryostats down to the laboratory follows the reverse sequence of §5.8:

1. Bring down the auxiliary cryostat crane support to level 5 using a trolley and the elevator.
2. Bring down the auxiliary cryostat to level 5 using the elevator.
3. Hook auxiliary cryostat crane support structure to the telescope crane .
4. Hook auxiliary cryostat to the support structure:
   a. On the side with the gate, adjust the length of the chain by placing the according hook in the 9th chain element.
   b. On the other side, no adjustment is needed.
5. Lift down the cryostat through the hatch to level 1.
6. Bring down trolley to level 1 using the elevator.
7. Place auxiliary cryostat back on its trolley.
8. Push auxiliary cryostat back to laboratory.
9. Store auxiliary cryostat crane support structure next to the wall below the hatch.

5.22 ~~Re-evacuation~~Pumping -of the auxiliary cryostats

To re-evacuate the auxiliary cryostats, first prepare the cryostats (see also §5.1):

1. Hook up the power supply of the auxiliary cryostat (cable in toolbox at the bottom of the cryostat).
2. Hook up the pressured air (pipe also in the toolbox).
3. Connect cable P103 from instrument electronics to J103 connector on the panel for the power- and pressurized air supply.
4. Switch on both circuit breakers (one for scroll pump, one for the control electronics) at the back the auxiliary cryostats.

And then evacuate *the start the according programs* (?) on the auxiliary cryostat control panel (see also §5.6):

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5. Switch on the scroll pump by pressing the "Scroll Pump" button switch. The light of the "Scroll Pump" button must turn on.
6. Start turbo molecular pump by pressing the "Evacuation Cryostat" button:
    a. The light of the button will turn on.
    b. The controller will wait for the scroll pump to evacuate for a pressure better than 10^{-1} mbar , and then switch on the turbo pump.
    c. The ~~according~~ corresponding "ACCEL" LED indicator of the "Pump Auxiliary Cryostat" turbo controller will turn on, until the turbo pump reaches it nominal speed.
    d. The ~~according~~ corresponding "NOMINAL" LED indicator of the "Pump Auxiliary Cryostat" turbo controller will turn on.
7. Wait for the pressure to be below 10^{-4} mbar. The according "Evacuation P<10^{-4}" will turn on.

5.23 Warming up the auxiliary cryostat

To warm up the auxiliary cryostat:

1. Keep pumps running.
2. Check that the temperature set point (green display of the OMEGA temperature controller) is set to 20° C.
3. Turn on the heater by switching on the "Heater On" switch:
    - The "Warming up" LED indicator will go on.
    - The OMEGA controller will automatically warm the cryostat to the set point temperature.
    - The "Heater 1" to "Heater 3" LEDs will indicate if the heaters are on.
4. Wait for about 12 hours ~~to warm up the cryostat~~for the cryostat to warm up.
5. Check that the cryostat temperature (red display of the OMEGA controller) is at or above the set point (green display).
6. Switch off the "Heater On" switch. The "Warm up" LED indicator, and the "Heater 1" to "Heater 3" LED indicators (if currently active) will turn off.
7. Switch off the cryostat evacuation by releasing the "Evacuation Cryostat" button. The ~~according~~ corresponding light of the button will go off.
8. Stop the scroll pump by releasing the "Scroll Pump" button. The ~~according~~ corresponding light of the button will go off.

5.24 Storing the auxiliary cryostats

The auxiliary cryostats are best stored when:

1. Warm (see §5.23 for warm up sequence).
2. Evacuated (see §5.6 and §5.22 for evacuation sequence) .

Then :

1. Switch off the power supply for the control electronics and the scroll pump at ~~the back of~~ the back of the E-cabinet.
2. Unplug the power supply.
3. unplug the pressurized air

Store all accessories in the dedicated tool boxes at the bottom of the auxiliary cryostats.

5.25 Testing the new masks

Once the mask configuration has been updated, using the LUCIFER observer session, move masks into the focal plane, using the Instrument Control GUI. This can easily be performed by the LBTO instrument scientist(s) since this is the same thing as when observing, Taking through mask images (N3.75 camera and Br_gam filter)~~To be done.~~ Is a good way to check that the mask has been inserted properly and the mask seen is indeed the one indicated in the configuration file (step #7 of cabinet exchange). Careful: Do not put all 23 new masks in the focal plane at once, that would heat up the MOS unit too much. Five to 7 masks at a time is fine but then let the unit cooldown for a while (an hour or two).

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